Synopsis of GVAR Format Changes   16 May 2001
Resulting From   Revision 1
MBCC, GOES M/N and GOES O/P/Q Imager Channel Changes

Rev 1: Only changes are in Section "**GVAR Changes Resulting From MBCC:**" They are:

- for Imager Documentation Block 0:
  - IMBCG1M is now a 7 word field [1x7] occupying words 6290-6296
  - words 6297-6303 are now spares

- for Imager Calibration & Limits Block 11:
  - IMBCC is now IMBCCI

Note that the field IMBCG1M in the Block 11 remains 14 words in length.

Introduction

The GOES Variable (GVAR) data transmission format which is used to broadcast meteorological data measured by the independent Imager and Sounder instruments aboard NOAA/NESDIS's Geostationary Operational Environmental Satellites (GOES) is being changed to accommodate a Midnight Blackbody Calibration Correction (MBCC) algorithm applicable to the Imager on all GOES I-M and GOES N-Q spacecraft and for changes to the Imager instrument channels on GOES-M/N and again on GOES-O/P/Q. This synopsis describes the changes in considerable detail and points the user to the files on the NOAA OSD web site which describe the GVAR Blocks in detail.

Since the changes for MBCC involve the use of what were formerly spare words for inclusion of imager MBCC related information the impact on user software should be minimal, if any. The GOES-M channel changes, however, result in storing imager channel/detector related information in a different order (the format doesn't actually change) so existing user processing must change to correctly interpret the data. The GOES O channel changes include an additional detector, the eighth, which results in many additional fields within the format (using former spare words at the end of the blocks or a new block if not enough space was available) and the creation of an additional block 11 to hold imager factory coefficients, since, with the additional detector, block 0 cannot accommodate all imager factory coefficients. Because of the channel changes there will have to be different versions of the GVAR format for different GOES spacecraft beginning with GOES-M. To identify the GVAR version of a received GVAR data stream use will also be made of the existing "Version Number" field found in the GVAR block header. The value in this field has always been set to zero in the past.

More details on the changes follow:

Version Number Changes

As stated above there is no change in the "Version Number" field which resides in Word 8 of the GVAR block header but values 0 thru 3 now have assigned meaning as follows:

Ver #	Spacecraft Supported	Change in relation to Version #0
0	GOES I thru L	Not applicable, this version is currently in use
1	GOES I thru L	MBCC information added

		Change in relation to Version #1
2	GOES M thru N	Imager IR Channel order in Block 1 & 2 changed
		New Block 11 added for imager factory coefficients
		Note: the imager coefficients remain in Block 0 as well

Spacecraft

Ver #	Supported	Change in relation to Version #1
3	GOES O	Imager IR Channel order in Block 1 & 2 changed (same as Ver #2)
		New Block 11 added for imager factory coefficients including coefficients for the 8th detector
		Modified blocks for eighth detector:

  Imager Block 0
    Imager factory coefficients removed
    Added data for 8th detector to existing block (using spares at the
       end of the block)
  Imager Block 2
    Added data for 8th detector to existing block (using spares at the
       end of the block)
  Imager Blackbody Block 11
    Added a 3rd block (necessary for 8th detector)
  Imager Calibration & Limits Block 11
    Added data for 8th detector to existing block (using spares at the
       end of the block)
  Imager ECAL Block 11
    Added a 3rd block (necessary for 8th detector)
  Imager Spacelook Block 11
    Added a 7th block (necessary for 8th detector)

Note that the Version #2 and #3 changes to GVAR outlined above will not be retroactive. Data from GOES-8 through GOES-11 will always be transmitted to users with Version #0 (currently) and with Version #1 in the future.

MBCC Incorporation

During the months between April and October (GOES -8), and all year (GOES-10), the computed calibration slopes for the imager IR channels exhibit anomalous dips in the approximately eight hours centered on satellite midnight. The amplitudes of the dips decrease with increasing wavelength. It is believed that these dips are actually errors in the slope computations, based upon a 1988 ITT prediction (Annable) and a study by NESDIS which correlated the dip with errors--of the order of 1 K-- in the measurement of ocean surface temperatures seen by the University of Wisconsin. Annable showed that radiation from the INR sun shields in the imager's scan cavity, which could reach temperatures up to 350K, could be reflected by the imager's internal blackbody to its detectors during the blackbody sequence. The extraneous radiation from the sun shields would cause slope errors with characteristics similar to the dips we see in orbit.

The MBCC is a software procedure which corrects the calibration slopes for this effect.

GVAR Changes Resulting From MBCC:

GVAR changes for MBCC are transparent to GVAR users since the added fields use what were previously spare words. The new fields are:

Block: Imager Documentation Block 0

Words	Name	Description/Values
6290-6296	IMBCG1M	Actual IR calibration first order gain mode (slope computation mode for each of 7 detectors) [1x7] Expected values: 1-14

Block: Imager Calibration & Limits Block 11

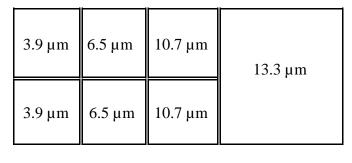| Words	Name	Description/Values
503-516	IMBCCI	Indicates the status of the MBCC Expected values: 0 -indicating MBCC is inactive 1 -indicating MBCC is active but regression is not used 2 - indicating MBCC is active but regression is used
517-530	IMBCG1M	Actual IR calibration first order gain mode (slope computation mode for each of 7 detectors) [2x7]

Imager Channel Changes

For GOES-M and -N, the selection of infrared channels on the GOES Imagers will be different from that currently on GOES-8 through -11. **Users will probably need to modify their GVAR ingest software to accommodate this change.** The current 12-µm channel (channel 5), which has two 4-km detectors, will be replaced by a 13.3-µm channel with one 8-km detector. The current 6.7-µm channel (channel 3), which has one 8-km detector, will have two 4-km detectors, and its spectral response will be shifted slightly and broadened, giving it a nominal center wavelength near 6.5 µm. **The visible channel (channel 1) will be unchanged.**

The current GOES-8 through -11 detector configuration is as follows:

3.9 µm		10.7µm	12 µm
3.9 µm	6.7 µm	10.7µm	12 µm

channel number: 2   3   4   5

The GOES-M and -N detector configuration will be as follows:

3.9 µm	6.5 µm	10.7 µm	
3.9 µm	6.5 µm	10.7 µm	13.3 µm

channel number: 2   3   4   6

To keep the channel numbering system consistent among satellites, NOAA will always maintain the same association between channel number and wavelength. Also, NOAA will number the channels in order of increasing wavelength. The new 13.3-µm channel will be labeled channel 6 to distinguish it from the old 12-µm channel (channel 5). (But since we assume the old 6.7-µm and the new 6.5-µm channel are effectively the same, both are channel 3.)

The channel numbering for all satellites from GOES-8 through GOES-P will therefore be as follows:

Channel	Nominal Wavelength
1	Visible
2	3.9 µm
3	6.7 or 6.5 µm
4	10.7 µm
5	12.0 µm
6	13.3 µm

Note that no imager will have both channels 5 and 6. Those on GOES-8 through GOES-11 have channel 5. Those on GOES-M through -P will have channel 6. For GOES-Q, it is TBD.

This numbering system will be incorporated in the index LICHA, which is word 5 of the line documentation segment of each record of GVAR blocks 1 and 2.

Beginning with GOES-O, another change will be made--channel 6 will have two 4-km detectors instead of one 8-km detector. The configuration will be as follows:

3.9 µm	6.5 µm	10.7 µm	13.3 µm
3.9 µm	6.5 µm	10.7 µm	13.3 um

channel number: 2   3   4   6

The observations in the infrared channels of the imagers are sent to users in blocks 1 and 2 of the GOES VARiable data stream (GVAR). For GOES-8 through GOES-11, the GVAR does not order the channels according to increasing wavelength, but by the arbitrary system, 4, 5, 2, 3. (This ordering was based on the old pre-GOES-8 AAA data stream).   Beginning with GOES-M, this will be changed. The data in GVAR will be in order of increasing channel wavelength. For example, for GOES-M through GOES P the order will be 2, 3, 4, 6.

The new ordering will apply only to the GVAR for GOES-M and beyond.   The original GVAR ordering will be maintained for GOES-8 through GOES-11 throughout their lifetimes on orbit.

GVAR Changes Resulting From Channel Reordering:

The order of the assignment of channels to the records in blocks 1 and 2 of GVAR will be changed, beginning with GOES-M. For GOES 8 through GOES-11, it is

Block 1 (four IR records)

Ch 4 (10.7 µm)   North detector
Ch 4 (10.7 µm)   South detector
Ch 5 (12.0 µm)   North detector
Ch 5 (12.0 µm)   South detector

Block 2 (three IR records)

Ch 2 (3.9 µm)   North detector
Ch 2 (3.9 µm)   South detector
Ch 3 (6.7 µm)

The terms "North" and "South" detectors refer to the Earth frame of reference.

For GOES-M and beyond, the records will be ordered with increasing wavelength. For GOES-M and -N the order will become

Block 1 (four IR records)

Ch 2 (3.9 µm)   North detector
Ch 2 (3.9 µm)   South detector
Ch 3 (6.5 µm)   North detector
Ch 3 (6.5 µm)   South detector

Block 2 (three IR records)

Ch 4 (10.7 µm)   North detector
Ch 4 (10.7 µm)   South detector
Ch 6 (13.3 µm)

And for GOES-O and -P it will become

Block 1 (four IR records)

Ch 2 (3.9 µm)	North detector
Ch 2 (3.9 µm)	South detector
Ch 3 (6.5 µm)	North detector
Ch 3 (6.5 µm)	South detector

Block 2 (four IR records)

Ch 4 (10.7 µm)	North detector
Ch 4 (10.7 µm)	South detector
Ch 6 (13.3 µm)	North detector
Ch 6 (13.3 µm)	South detector

The word LICHA in each record's line documentation segment indicates the channel number.

GVAR Changes Resulting From the Additional Infrared Detector:

Beginning with GOES-O, the imagers will have eight, instead of seven, IR detectors. In block 0, the amount of space for the drift correction coefficients (currently words 5587-6289) has to be increased to accommodate the data for the eighth detector. To make room in block 0, the imager factory coefficients (currently words 6305-8030) will be removed and stored in the new "Imager Factory Coefficients" block 11. The drift coefficients for the eighth detector will be stored in words 6309-6403 followed by the MBCC data for the eighth detector in words 6404-6405. [The reason we retain the drift correction data but not the factory data in block 0 is that the drift correction data are updated with each scan line, whereas the factory coefficients remain the same for a given satellite for all time. (And, of course, blocks 0 are sent with each scan line, whereas blocks 11 are sent less often.)]

The new "Imager Factory Coefficients" block 11 will be introduced early with the GOES-M satellite. This block 11 will be identified by the value "20" in words 5 and 6 ("Product ID") of the GVAR block header. However, the changes to block 0, including the removal of the Imager factory data and the addition of drift correction data and MBCC data for the eighth IR detector, will not become effective until GOES-O. This Imager Factory Coefficients Block 11 will be sent at the start of the imager frame and at the lowest priority of all other block 11's but just before "fill block".

The following blocks also require changes to accommodate data for the eighth detector:

- Imager Blackbody Statistics Block 11 - a third block is added

- Imager Calibration & Limits Block 11 - spare fields at the end of the block are used

- Imager ECAL Block 11 - a third block is added

- Imager Spacelook Block 11 - a seventh block is added

Detailed Format Specifications

Detailed format specifications can be found on the GVAR pages at the NOAA OSD Web site (www.osd.noaa.gov). Available as files are the current GVAR format description (Version #0) as specified in Section 3 of DRL 504-02, a recent letter to GVAR users regarding the upcoming GVAR changes, this paper, the latest information regarding test broadcasts, and detailed block descriptions of the blocks changed/added for Versions #1, 2 and 3. Note that Version #3 block descriptions are still preliminary primarily because the location of longitudinal parity fields are yet to be determined.

DRL 504-02 updates for Versions 1, 2 and 3 will be posted at this site when available.